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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II

JACOB K. JAVITS FEDERAL BUILDING

NEW YORK, NEW YORK 10278-0012

ACTION MEMORANDUM

DATE: JUL 14 1993

SUBJECT: Request for a Ceiling Increase and a Removal Action Restart at the National Lead Industries Inc. Site, Pedricktown, Salem County, New Jersey

FROM: Eugene Dominach, On-Scene Coordinator
Removal Action Branch - Section A

TO: William J. Muszynski, P.E.
Acting Regional Administrator

THRU: George Pavlou, Acting Director
Emergency and Remedial Response Division

Site ID-#: 61

I. PURPOSE

The purpose of this Action Memorandum is to request and document approval of the removal action and ceiling increase described herein for the NL Industries, Inc. (NL) Site (Site) located in Pedricktown, Oldmans Township, Salem County, New Jersey. The NL Site is included on the National Priorities List (NPL) and continues to meet the criteria for a removal action under the Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA), as described in Section 300.415 of the National Contingency Plan (NCP). The proposed removal action is estimated to cost $1,237,700, of which $934,100 is from the Regional removal allowance. The new total project ceiling will be $1,980,900.

II. SITE CONDITIONS AND BACKGROUND

The Salem County Mosquito Commission (SCMC) has proposed to widen and deepen a portion of the West Stream that crosses the NL Site to alleviate flooding and improve drainage in areas upstream of the Site. However, analytical data generated during the Remedial Investigation/Feasibility Study (RI/FS) indicated that sediments in the stream contain lead at levels up to 26,800 parts per

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million (ppm). The elevated levels of lead in the soil and stream sediments are the result of the smelting, handling and storage activities conducted at the NL Site. Due to the critical nature of the contaminated soil and stream sediments and the local flood control problem, the proposed action has been referred to the Removal Action Branch (RAB) for consideration. Action is also needed to prevent further spreading of contamination and to ensure proper disposal of excavated materials. The funding requested in this memorandum is necessary for the excavation, testing, staging and proper disposal of the contaminated soil and sediments. The contaminated soil and stream sediments are to be removed to a depth of one foot and the stream width increased to fourteen feet. The total quantity of material to be excavated is approximately 1,700 cubic yards, based on data previously collected at the site. Figures 1 and 2 show the general Site location and layout. Figure 3 shows the planned area of work, which extends from the south side of Pedricktown Road to the north side of Route #130, a length of approximately 3,300 feet.

The category of this removal action is time-critical and the Comprehensive Environmental Response, Compensation and Liability Information System number for this Site is NJD061843249.

A. Site Description

1. Removal site evaluation

The NL Industries Site is an abandoned, secondary lead smelting facility. In 1972, the NL facility began operations by reclaiming and recycling lead from automotive batteries. Residual materials and the slag produced from the smelting process were disposed in the on-site landfill. During its period of operation, NL was cited by the New Jersey Department of Environmental Protection and Energy (NJDEPE) with various and repeated violations of the state air and water regulations. In 1983, NL sold the facility to National Smelting of New Jersey, Inc. (NSNJ).

In 1984, NSNJ ceased operations and declared bankruptcy. Remaining on-site when operations terminated were four slag piles having an estimated volume of approximately 9,800 cubic yards, 4,000 cubic yards of contaminated debris, 25 tons of hazardous materials stored in the warehouse and approximately 900 cubic yards of lead bearing raw materials in drums and containers in various locations throughout the Site. The containers, due to exposure to the elements, age and corrosion, posed a threat of release to the environment.

The County of Salem has proposed a flood control project for the West Stream to ease flooding conditions to residences and farmlands upstream of the Site. The project will involve the

removal of sediment and widening of the stream. During the RI, stream sediments were sampled and analyzed in 1988, 1989 and 1990. The mean concentration for lead in the West stream was reported as 1,340 ppm and the maximum concentration was 26,800 ppm adjacent to the plant area. Due to the elevated levels of lead in the stream sediment, the proposed project for the West Stream cannot be safely undertaken by the County. The scope of the proposed stream widening project is shown in Figures 3 and 4.

2. Physical location

The NL site is located on Penns Grove-Pedricktown Road in Pedricktown, Salem County, New Jersey. The 46-acre site, which overlies the Cape May aquifer, is bordered by two small intermittent streams, which are tributaries to the Delaware River. The West Stream receives surface runoff from the site. The Delaware River is approximately 1.5 miles north of the site. The site location map is shown in Figure 1.

The NL facility is situated within an industrial park that includes B.F. Goodrich, Martin Propane Gas Service, Pioneer Pallet, Exxon (inactive), and The Corrosion Control Co. A Conrail easement bisects the property, separating a closed NJDEPE permitted landfill to the north from the former smelting operations area to the south.

3. Site characteristics

The NL site is an abandoned lead reclamation facility that operated from 1972 through 1984, recycling lead from automobile and industrial batteries, and from lead bearing materials. The site map is shown in Figure 2.

During the facility's operational history, NL Industries was cited by the NJDEPE on numerous occasions for violations of State air and water quality standards. As a result of the enforcement actions, NL Industries modified their process to comply with NJDEPE regulations. NL Industries sold the facility to National Smelting of New Jersey (NSNJ) in 1983. NSNJ operated the facility from 1983 to 1984, when operations were ceased before NSNJ filed for bankruptcy. The facility has been vacant since 1984. NL Industries entered into an AOC with EPA to conduct a Remedial Investigation/Feasibility Study (RI/FS), effective on April 30, 1986.

The RI report for Operable Unit One of the site was approved on July 8, 1991 and the Final FS report was submitted to EPA in May 1993.

In September 1991, EPA issued a Record of Decision (ROD) for Operable Unit Two of the Site, which addressed contaminant

sources within the paved industrial area. These sources included the slag and lead oxide piles, contaminated debris, contaminated surfaces (including buildings), and contaminated standing water. The selected remedy included on-site stabilization and disposal of the slag piles, decontamination of contaminated surfaces, off-site treatment and disposal of contaminated standing water, and recycling of recyclable material (including the lead oxide piles and scrap metal).

In March 1992, EPA issued a Unilateral Administrative Order to 31 Potentially Responsible Parties (PRPs) requiring them to implement the selected remedy for Operable Unit Two. At the same time, EPA issued an Explanation of Significant Differences, which allowed the treated slag to be disposed of off site. Remedial activities for Operable Unit Two of the site are expected to be completed during September of 1993. During the remediation, the PRPs have chosen to demolish and remove the on-site buildings after they have been decontaminated.

The proposed site activity is a restart and the fifth removal action since the Removal Action Branch's initial involvement at the site. Details relating to the previous removal actions at the site are contained in Section II.B of this Action Memorandum.

4. Release or threatened release into the environment of a hazardous substance, or pollutant, or contaminant

The NL site is characterized by the presence of highly toxic metals. The heavy metals identified in the stream sediments at the site include: Antimony, arsenic, cadmium, chromium, copper, lead and zinc. Each of these are designated hazardous substances under Section 101(14) of CERCLA as listed in CFR Table 302.4. Routes of exposure are inhalation, ingestion and skin or eye contact. Figure 5 of Appendix A is a Toxic Effects chart of the metals found on-site.

Concentrations of lead in excess of 500 ppm, found in the stream sediments are the result of the smelting, storage and disposal activities conducted at the NL site. The total quantity of material to be excavated is approximately 1,700 cubic yards, based on the current data.

Flooding and subsequent erosion could potentially accelerate the release of heavy metal contaminated sediments. Overflow of the streams banks could deposit lead contaminated sediments on adjacent properties. Flooding of the stream could transport contaminated sediments farther downstream, affecting the water quality of the Delaware River. Dried sediment could become airborne and expose humans and environmental receptors to lead bearing dust.

5. National Priority List status

This site was placed on National Priorities List in December 1982, and is currently ranked number 135. A Remedial Action addressing surface waste, under Operable Unit Two, has been on-going since November 1992.

6. Maps, pictures and other graphic representations

The Site location map (Figure 1), a Site map (Figure 2), stream widening project maps (Figures 3 and 4) and a Toxic Effects chart (Figure 5) are included in Appendix A.

B. Other Actions to Date

1. Previous actions

To date, only government and private actions have been undertaken at the Site. The EPA has completed four removal actions at the Site. A brief description of each is provided below.

Phase I - On December 19, 1988, funding was approved to conduct a removal action at the Site, consisting of repairs to the existing fence, installation of 900 feet of new chain link fence, the posting of warning signs and the temporary encapsulation of the slag piles to minimize airborne releases from the Site. The project was completed on May 31, 1989, at a cost of $77,555.

The newly installed section of fence isolated the facility from the landfill, but was not fully effective in limiting access as several break-ins were reported. The slag encapsulant degraded over time.

Phase II - Phase II was initiated on October 11, 1989 and consisted of inventorying the on-site hazardous and recyclable materials stored in deteriorating containers; upgrading building security, including the installation of fence gates and locks on all building entrances; re-encapsulating the slag piles to prevent the release of airborne particulates; constructing sand berms around the perimeter of the slag piles to prevent runoff from the site caused by adverse weather conditions; recycling of 22 tons of raw materials stored on-site; and off-site disposal of two tons of hazardous waste.

In April 1990, after partial failure of the slag encapsulant had occurred and potential release of the slag became imminent, the slag pile retaining bin walls were reinforced with timber. The reinforcement was designed to provide temporary support to prevent total collapse of the bin retaining walls and release of the slag to the environment.

This phase was completed on September 20, 1990 at a cost of $376,010, of which $227,660 was expended for mitigation contracting.

was initiated on November 17, 1990 to curtail the entry of unauthorized persons who wished to remove the wire.

Other activities performed in Phase III were the transferring and relocation of the contents of exterior stored steel and fiber drums that contained lead bearing waste to dry and sheltered on-site storage areas and the recycling of 2,200 steel drums. Relocation of the contaminated waste from the deteriorating containers was necessary to eliminate future discharges into the environment via airborne particulates and surface runoff.

Phase III was completed on July 25, 1991 at a cost of $186,720, of which $135,280 was for mitigation contracting.

Phase IV - Phase IV was initiated on June 18, 1992 and consisted of the replacement of damaged wood shoring to two slag bin retaining walls, the repair of the perimeter fence and building gates damaged by vandals and the upgrading of the slag pile berms to control runoff.

Phase IV was completed on June 26, 1992, at a cost of $45,715, of which $44,155 was for mitigation contracting.

2. Current actions

An RI was completed in July 1991 and an Final FS Report was submitted to EPA in May 1993. At this time, the PRPs are on-site and have completed the treatment and disposal of all slag. The lead oxide piles and large amounts of debris have been removed and recycled. Several hundred thousand gallons of contaminated standing water have been sent off site for treatment and disposal. The decontamination and demolition of the buildings is continuing and is expected to be completed during September 1993. After all buildings and debris have been removed, the paved area of the site will be regraded to prevent further accumulation of water.

Excavation of the contaminated stream sediments may be initiated at this time. Lead contaminated runoff from the slag piles is no longer available to contribute to the contamination of the stream. Upon EPA request, the SCMC will provide an access road for the length of the stream widening project by removing all surface vegetation. The SCMC will then stake out the boundaries of the area they intend to excavate for the widened West Stream, prior to initiation of EPA's removal activity.

C. State and Local Authorities' Roles

1. State and local actions to date

In 1986, the NJDEPE Division of Hazardous Waste Management transferred Site responsibility to the EPA to initiate safety measures as part of a long-term CERCLA Site cleanup. The State contended that the unguarded Site was a public health threat due

a threat to the environment. The Site was subject to vandalism, trespassing, and following heavy rains, leachate from the lead-bearing material overflowed to the surrounding soil and groundwater.

2. Potential or continued State/local response

EPA has completed a ROD for Operable Unit Two of the site. Notice letters have been issued to 56 companies identified as PRPs. The NJDEPE has concurred with the remedy selected in the ROD. EPA has coordinated major aspects of site remediation with the NJDEPE.

III. THREAT TO PUBLIC HEALTH, OR WELFARE, OR THE ENVIRONMENT AND STATUTORY AND REGULATORY AUTHORITIES

The following criteria from Section 300.415(b)(2) of the NCP are directly applicable to the threats that exist at the NL Site:

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, or pollutants, or contaminants;

(ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) High levels of hazardous substances, or pollutants, or contaminants in soils largely at or near the surface that may migrate;

(v) Weather conditions that may cause hazardous substances, or pollutants, or contaminants to migrate or be released; and

(vii) The lack of availability of other appropriate federal or state response mechanisms to respond to a release.

A. Threats to Public Health and Welfare

The Agency for Toxic Substances and Disease Registry (ATSDR) Health Assessment for the Site confirms that possible human and animal exposures include: ingestion, direct contact with groundwater/surface water and soil, possible ingestion of bioaccumulated contaminants in the food chain and inhalation of entrained contaminants. (See Toxic Effects Chart, Figure 5.) Concentrations of lead found in the West Stream greatly exceed EPA's recommended soil cleanup range of 500-1,000 ppm (OSWER Directive #9355.4-02 "Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites").

Several conditions of the stream increase the above mentioned risks. The buildup of sediment in the stream prevents proper drainage and causes flooding. Flooding could carry contaminated sediments, spreading contamination and possibly increasing the

sections during dry periods. Therefore, humans and animals could potentially be exposed to dried contaminated sediment for extended periods of time.

B. Threats to the Environment

The surface water in the West Stream contains lead in excess of EPA's Ambient Surface Water Quality Criteria for freshwater streams. Contaminated sediments contribute to poor surface water quality in the West Stream.

An ecological risk assessment was conducted during 1992 at the site by EPA's Environmental Response Team. It included a study of contaminant uptake by ecological receptors located at the site, as well as bioaccumulation modeling of contaminant uptake by higher organisms. The results of the ecological study and risk assessment were used in developing remedial action objectives.

The results of the ecological risk assessment indicate that a clean-up level of 500 ppm for site soils and sediments is appropriate to address the risks to ecological receptors.

IV. ENDANGERMENT DETERMINATION

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Action Memorandum, may present an imminent and substantial endangerment to public health, welfare, or the environment.

V. PROPOSED ACTIONS AND ESTIMATED COSTS

A. Proposed Actions

1. Proposed action description

The proposed scope of work by EPA for this project includes the excavation of contaminated sediment and soil to a depth of 1 foot by 14 feet in width by 3,300 feet in length. The estimated volume of soil slated for removal is based on RI/FS sampling data which indicates that the levels of lead are generally below 500 ppm at the 1 foot level. Upon completion of the removal action, the SCMC will complete the stream enhancement by removing an additional 3 feet by 14 feet of soil. The project start is based on clearing of vegetation by the county to provide an access route to the stream, and staking the new route of the widened stream.

The project has been divided into three sections based on location. These sections are described below. Excavation in each section will be handled in a similar manner, in approximately 100 foot or less increments, based on stream

During a no-flow condition, excavation could proceed without restraint and a dry stream bed would not require diversion equipment. Therefore, the optimal time to perform the removal action is during August and September.

During a flow condition, provisions for sand-bag damming, sheet piling and diversion pumping methods will become necessary and varied equipment will be provided for.

a. **Excavation of Section 1**--will proceed in a northerly direction for a distance of 250 feet to the culvert at the south side of Pedricktown Road. Should a flow condition exist, water will be pumped and diverted in 100 foot sections as the excavation progresses. To block water, sandbags will be placed in the stream at the beginning and at the end of a 100 foot section. If necessary, steel pilings will be placed behind the sandbags for support and to minimize leakage. Water will be pumped around the excavation area. See Figure 3 for a schematic of the proposed pumping scheme for this and all sections.

b. **Excavation of Section 2**--will begin at the north side of Pedricktown Road and continue to the south side of the Conrail Railroad tracks. Should a flow condition exist, the stream will be dammed and the water pumped and diverted in 100 foot sections as per Section 1, described above. When the excavation reaches the rail road tracks, the south side of the culvert under the tracks will be sandbagged and the water pumped to the north side of the RR tracks. No provision is being made to increase the diameter of the culvert under the railroad tracks.

c. **Excavation of Section 3**-- will begin on the north side of the rail road tracks and continue north to Route #130. Should a flow condition exist, the stream will be dammed and the water pumped and diverted in 100 foot sections as per procedures outlined in the above sections.

Staging areas for stockpiling the excavated soil will be provided for along the stream access road. The soil will be staged and bermed on geotech fabric to prevent sediment leachate runoff. To prevent rain infiltration, the soil will be covered at night with visqueen and to facilitate drying, uncovered and turned over during the day, to allow for evaporation of water. The soil will be sampled and analyzed for TCLP-lead, and shipped for disposal to a facility in compliance with the Resource Conservation and Recovery Act (RCRA). Should analysis reveal that the soil cannot be landfilled without treatment (i.e. stabilization), the soil may be covered and remain on-site until the entire excavation has been completed and a proper treatment technology is prepared.

lead above 500 ppm exist in the stream sediment. Therefore, TCLP-metals analysis of the excavated sediment and soil is required to ensure proper disposal of the materials. After excavation, sampling and analyses will be conducted to verify that the cleanup level has been achieved in the sediments remaining in the West Stream.

2. Contribution to remedial performance

The implementation of this removal action will permanently eliminate the threat to health, or welfare, or the environment posed by the contaminants in the stream's soils and sediments.

3. Description of alternative technologies

Analytical data, implementability of alternative technologies, effectiveness and cost will be considered in evaluating treatment technologies. The possible alternative technologies include stabilization, solidification and soil washing/flushing. If after investigation it is determined that a alternative technology is not economically justifiable, the soil will be landfilled.

4. EE/CA

Since the proposed removal action is time-critical, this section is not applicable.

5. Applicable or relevant and appropriate requirements (ARARS)

Federal ARARs determined to be practicable for the Site are the Clean Water Act, RCRA and the Occupational Safety and Health Act. EPA will meet the ARARs associated with the scope of work of this removal action to the maximum extent achievable.

6. Project schedule

The removal activities proposed for the NL facility can be implemented within two weeks following approval of the Action Memorandum and construction of the access road by the County. The excavation, staging and disposal of the stream sediments is expected to be completed in 40 working days. Additional time will be required to complete the program should scheduling conflicts be encountered with removal constraints or unfavorable weather conditions.

B. Estimated Costs

Extramural costs:

Regional Allowance Costs:

Total Cleanup Contractor Cost (Including 20% contingency, Rounded)	$ 934,100
Other Extramural Cost Not Funded From the Regional Allowance:	
Total TAT, including multiplier cost	$ 74,500
Subtotal, Extramural Costs (Rounded)	$1,008,600
Extramural Cost Contingency (15%)	$ 151,300
TOTAL, EXTRAMURAL COSTS (Rounded)	$1,159,900

Intramural Costs:

Intramural Direct Cost	$ 56,700
Intramural Indirect Cost	$ 21,100
TOTAL, INTRAMURAL COSTS	$ 77,800
TOTAL, PROJECT CEILING (Rounded)	$1,237,700

NEW PROJECT CEILING

	Phases I-IV Authorized Ceiling	Phase V Estimated Budget	Project Ceiling
ERCS	$ 491,400	$ 934,100	$1,425,500
TAT	$ 113,490	$ 74,500	$ 187,990
Cont.	$ 3,510	$ 151,300	$ 154,810
EPA	$ 134,800	$ 77,800	$ 212,600
TOTAL	$ 743,200	$1,237,700	$1,980,900

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Delayed action will increase the health risk to persons and biota coming in contact with the Site's contaminated soils, sediments or runoff.

VII. OUTSTANDING POLICY ISSUES

At the present time there are no outstanding policy issues.

VIII. ENFORCEMENT

EPA has issued notice letters to 56 PRPs notifying them of their potential CERCLA liabilities. However, due to the time-critical nature of this request, a prompt removal activity is necessary to protect the public health and the environment.

IX. RECOMMENDATION

This decision document represents the selected removal action for the NL Industries Site in Pedricktown, New Jersey, developed in accordance with CERCLA, as amended, and not inconsistent with the NCP. This decision is based on the administrative record for the Site.

Conditions at the Site meet the NCP Section 30.415(b)(2) criteria for a removal and I recommend your approval for the proposed removal action. The new total project ceiling, if approved, will be $1,980,900, of which $1,425,500 is for mitigation contracting. This request represents an increase of $1,237,700, of which $934,100 is for mitigation contracting. Sufficient funding is available in our current Advice of Allowance to finance this phase of the removal action.

Please indicate your approval and authorization of funding, per current delegation(s) of authority by signing below.

APPROVAL: Kathleen C. Callahan **DATE:** 7/15/93
for William J. Muszynski, P.E.
Acting Regional Administrator

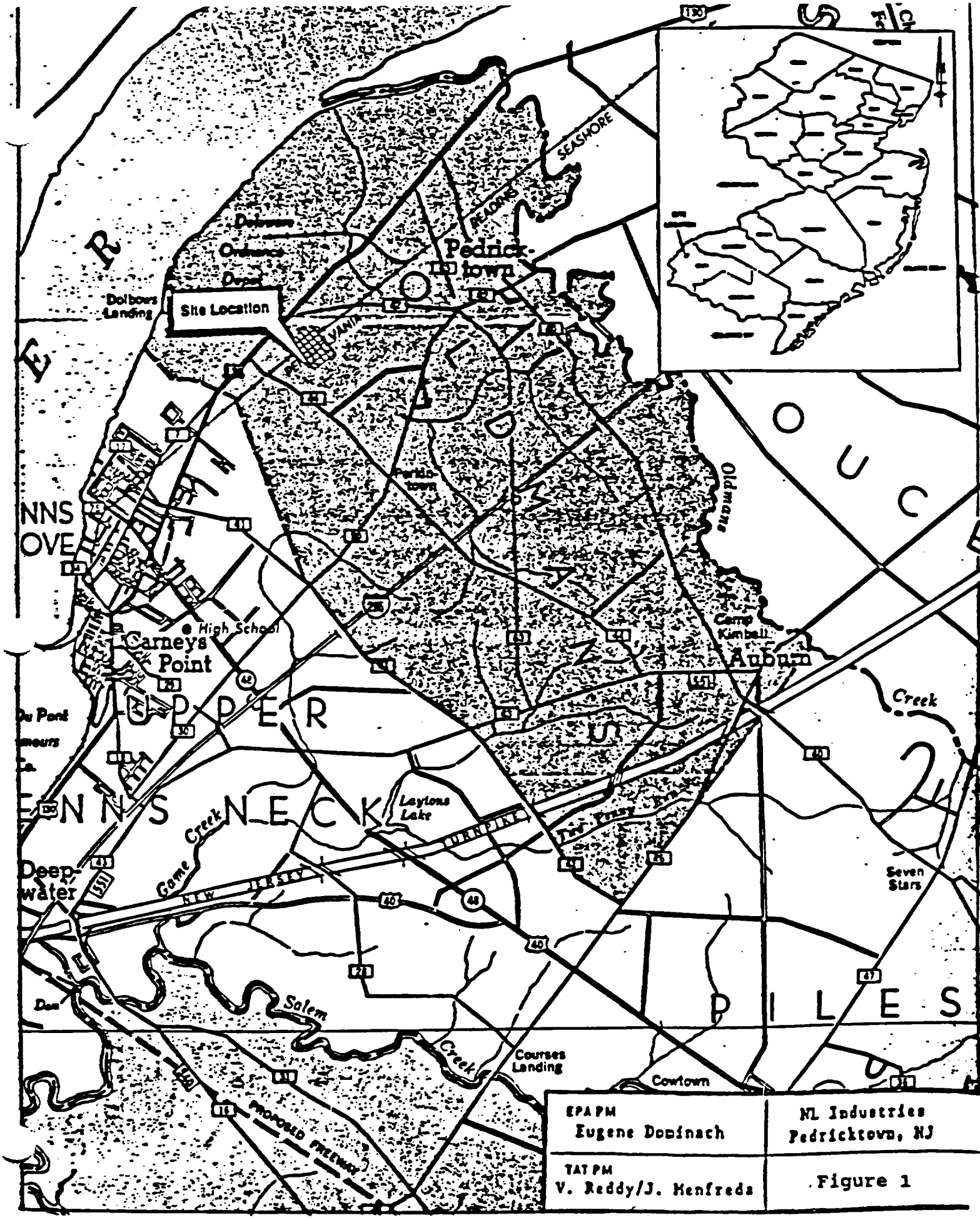
DISAPPROVAL: _____ **DATE:** _____
William J. Muszynski, P.E.
Acting Regional Administrator

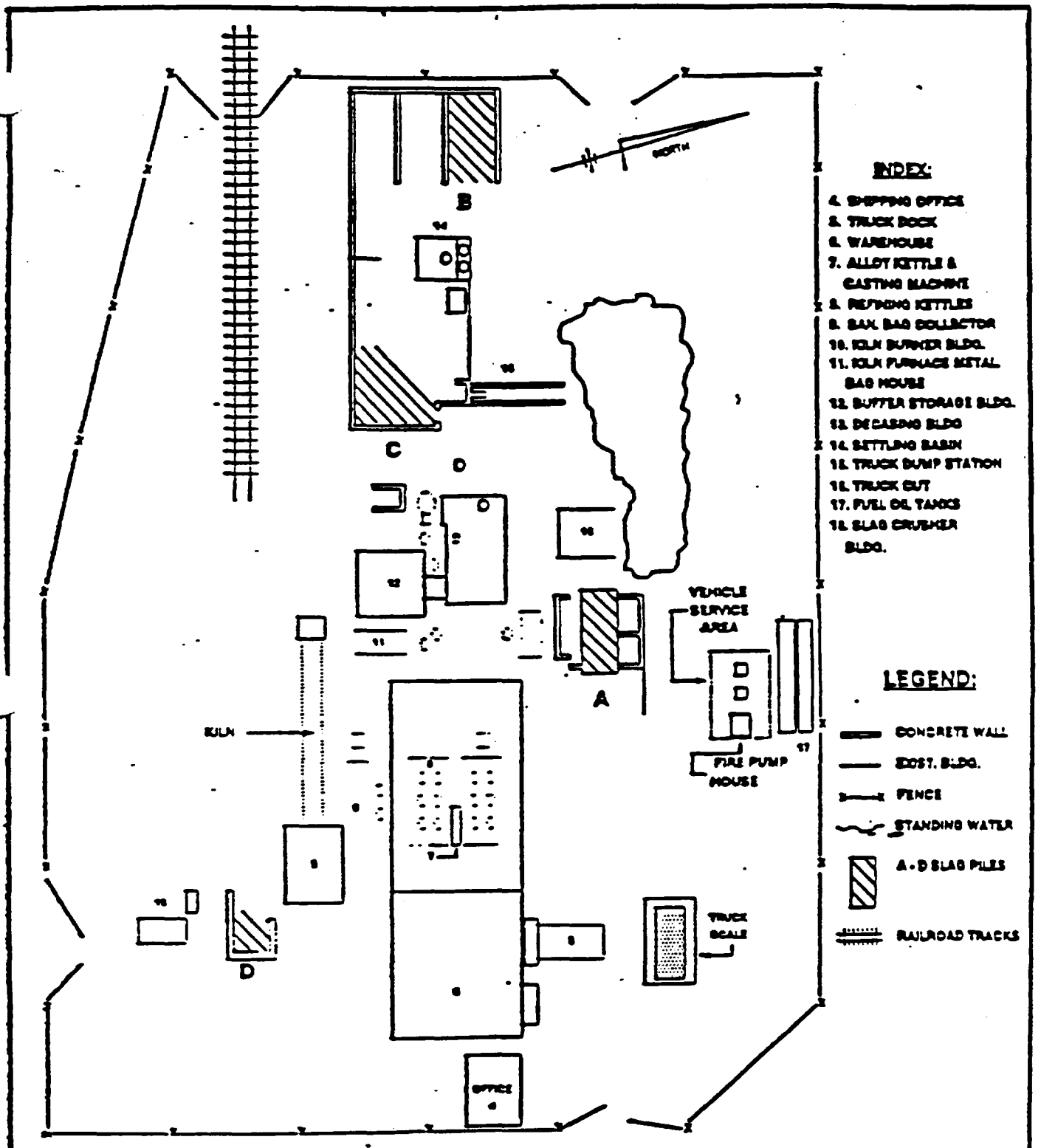
cc: (after approval is obtained)

K. Callahan, DRA
R. Salkie, ERRD-ADREPP
G. Zachos, ERRD-RAB
J. Marshall, EPD
P. Cutts OPM-FAM
D. Dietrich, 5202G
L. Miller, NJDEPE
D. Triggs, NJDEPE
C. Kelley, TATL
M. Gilbert, ERRD-SNJS-II
G. Pavlou, ERRD-D
J. Frisco, ERRD-DDNJP
M. Pane, ERRD-RAB-A
D. Karlen, ORC-NJSUP
R. Gherardi, OPM-FIN
T. Grier, 5202G
K. Kloo, NJDEPE
C. Moyik, ERRD-PS
D. Younger, PM-214F

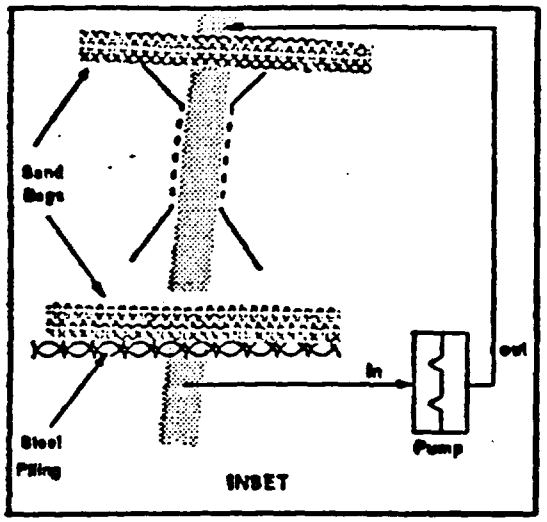
APPENDIX A

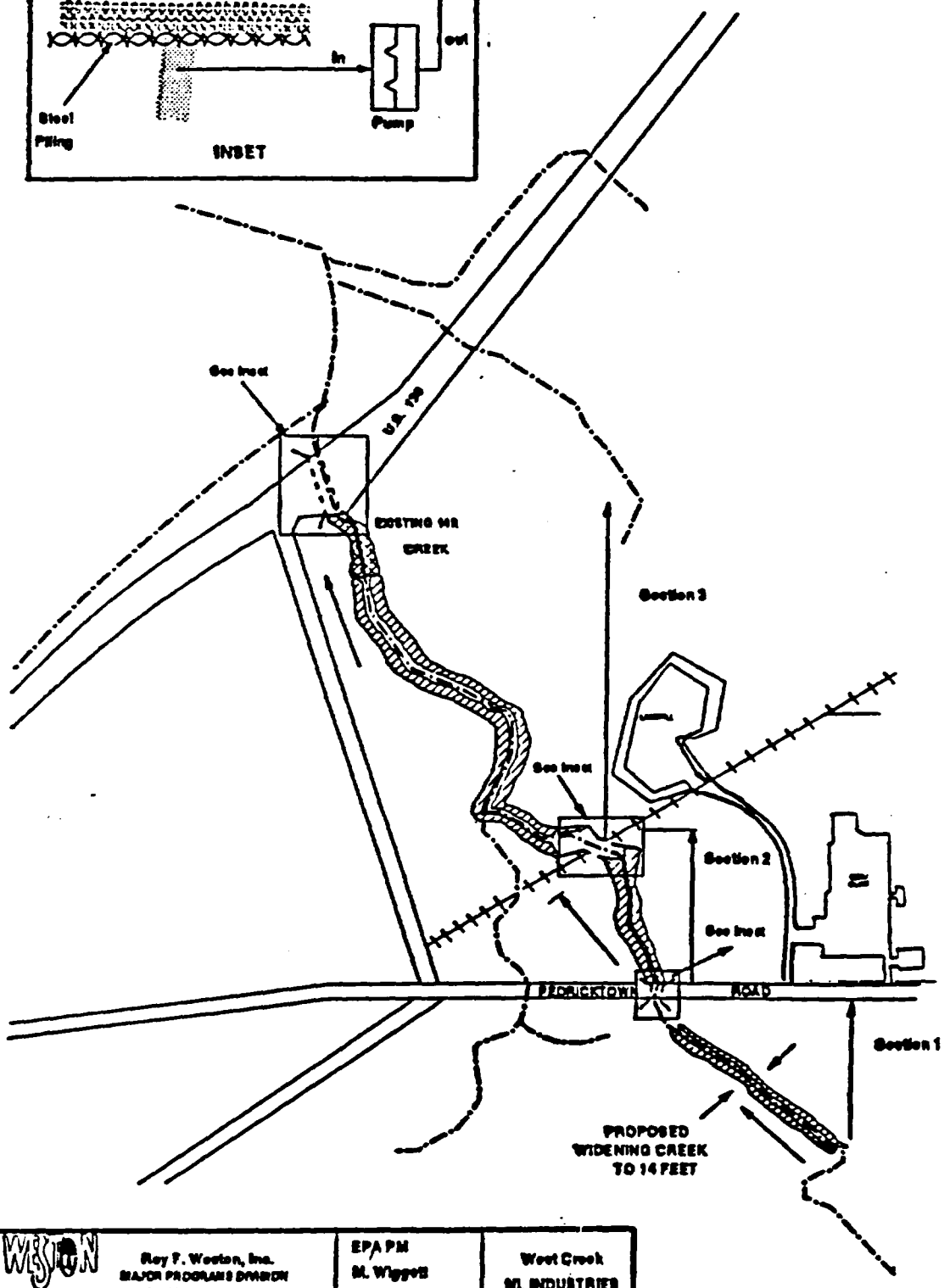
MAPS


Site Location
Pedricktown
Carneys Point
High School
Penns Grove
Oldmans
Camp Kimball
Auburn
Creek
Layton's Lake
Game Creek
Deepwater
Seven Stars
Salem
Courses Landing
Courtown
PILES
PROPOSED FREEWAY
EPA PM
Eugene Dominach
TAT PM
V. Reddy/J. Menfreda
NL Industries
Pedricktown, NJ
Figure 1

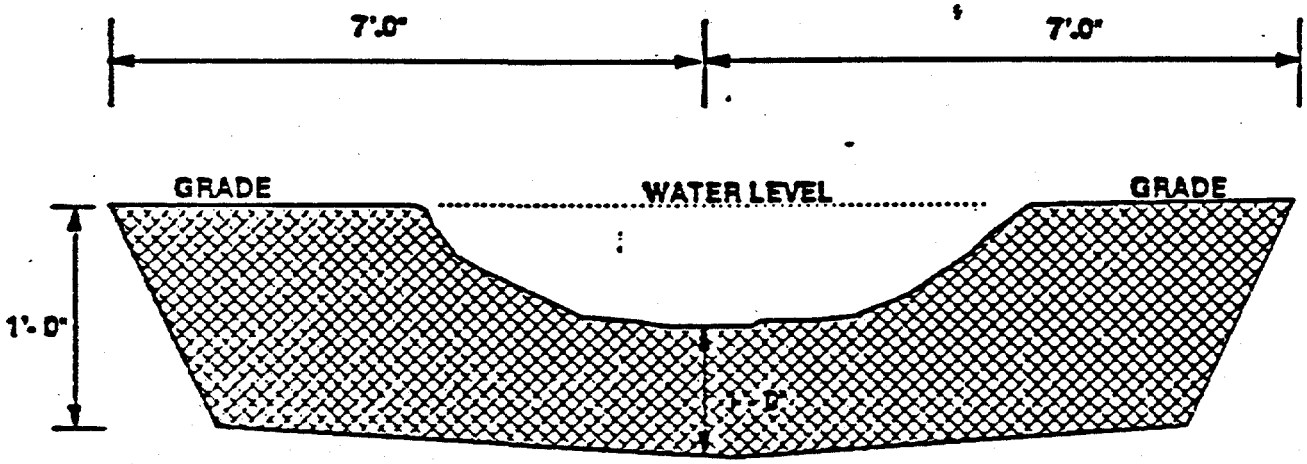


WESTON MANAGERS DESIGNERS/CONSULTANTS — Roy F. Weston, Inc. MAJOR PROGRAMS DIVISION	EPA PM E. Dominach	NL Industries Site Map
IN ASSOCIATION WITH FOSTER WHEELER CORP., C.C JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES	TAT PM J. Manfreda	Figure 2





WESTON Roy F. Weston, Inc. MAJOR PROGRAMS DIVISION MANAGING DESIGNING CONSULTANTS	EPA PM M. Wiggett	West Creek NL INDUSTRIES
IN ASSOCIATION WITH FOSTER WHEELER CORP., C.C JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES	TAT PM E.G. Dominesh	Figure 3



CROSS SECTION OF WIDENING PROJECT FOR ENTIRE LENGTH CREEK

DWN. BY JLH
DATE: 05-03-93
DWN.# NL-C

WESTON — Roy F. Weston, Inc. MAJOR PROGRAMS DIVISION	EPA PM M. Wiggett	West Creek NL INDUSTRIES
IN ASSOCIATION WITH FOSTER WHEELER CORP., C.C JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES	TAT PM E.G. Dominach	Figure 4

SUMMARY OF POTENTIAL TOXICOLOGICAL EFFECTS OF
SOME OF THE IDENTIFIED HAZARDOUS CHEMICALS AT:

NL INDUSTRIES

PEDRICKTOWN, NEW JERSEY

	CARCINOGEN	MUTAGEN	TERATOGEN	TOXIC BY INHALATION, INGESTION OR DERMAL CONTACT	CENTRAL NERVOUS SYSTEM DAMAGE	LIVER DAMAGE	CARDIOVASCULAR SYSTEM DAMAGE	LUNG DAMAGE	KIDNEY DAMAGE	LYMPHATIC SYSTEM DAMAGE	EYE, SKIN, RESPIRATORY & MUCOUS MEMBRANE IRRITANT
ANTIMONY				●			●				●
ARSENIC	●			●		●		●	●	●	●
BARIUM				●	●						●
BERYLLIUM	●			●				●			●
CADMIUM	●			●					●		●
CHROMIUM				●							●
COBALT				●							●
COPPER				●							●
CYANIDE				●	●		●	●	●		●
LEAD				●	●						●
MAGNESIUM				●							●
MANGANESE				●	●				●		●
MERCURY				●	●				●		●
NICKEL	●			●				●			●
SELENIUM				●		●			●		●
THALLIUM				●	●	●		●	●		●
VANADIUM				●							●
ZINC				●							●

DWN. BY: DR.
REVISED: 12-21-90
DWN. # 2EEED

WESTON DESIGNERS & CONSULTANTS — Roy F. Weston, Inc. MAJOR PROGRAMS DIVISION	EPA PM E. Dominach	TOXIC EFFECTS CHART
IN ASSOCIATION WITH FOSTER WHEELER CORP., C C JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS INC AND R E SARRIERA ASSOCIATES	TAT PM J. Manfreda	Figure 5.